

What is claimed is:

1. An abnormality diagnosis apparatus for diagnosing abnormality of a cooling system for an internal combustion engine, wherein the cooling system includes a radiator, a circulation line system, which circulates coolant through the internal combustion engine and the radiator and includes a bypass fluid line that bypasses the radiator, a flow rate control means for controlling a bypass flow rate of the coolant flowing through the bypass fluid line, and a coolant temperature sensor, which measures a coolant temperature of the coolant in the circulation line system, the abnormality diagnosis apparatus comprising:

a coolant temperature control means for controlling the coolant temperature of the coolant in the circulation line system by controlling the flow rate control means; and

an abnormality diagnosis means for diagnosing the flow rate control means to determine whether abnormality of the flow rate control means exists based on behavior of the measured coolant temperature, which is measured through the coolant temperature sensor during a warm-up period of the internal combustion engine.

2. The abnormality diagnosis apparatus according to claim 1, wherein the flow rate control means includes at least one of a valve and a pump inserted in the circulation line system.

3. The abnormality diagnosis apparatus according to claim 1, wherein the abnormality diagnosis means determines the existence of the abnormality of the flow rate control means based on one

of:

an amount of change in the measured coolant temperature measured through the coolant temperature sensor; and

a rate of change in the measured coolant temperature measured through the coolant temperature sensor.

4. The abnormality diagnosis apparatus according to claim 1, wherein the abnormality diagnosis means sets an abnormality diagnosis condition, which is used to determine the existence of the abnormality of the flow rate control means, based on:

a parameter, which relates to an amount of heat generated by the internal combustion engine; and

a parameter, which relates to an amount of heat released from the coolant.

5. The abnormality diagnosis apparatus according to claim 4, wherein:

the abnormality diagnosis means determines an estimated coolant temperature of the coolant in the circulation line system based on:

the parameter, which relates to the amount of heat generated by the internal combustion engine; and

the parameter, which relates to the amount of heat released from the coolant; and

the abnormality diagnosis means determines the existence of the abnormality of the flow rate control means through comparison of the estimated coolant temperature and the measured

coolant temperature measured through the coolant temperature sensor.

6. The abnormality diagnosis apparatus according to claim 1, wherein the abnormality diagnosis means corrects an abnormality diagnosis condition, which is used to determine the existence of the abnormality of the flow rate control means, based on one of:

the bypass flow rate; and

a bypass flow rate parameter, which correlates with the bypass flow rate.

7. The abnormality diagnosis apparatus according to claim 6, wherein the abnormality diagnosis means uses a controlled variable of the flow rate control means as the bypass flow rate parameter.

8. The abnormality diagnosis apparatus according to claim 1, wherein when the abnormality diagnosis means diagnoses the flow rate control means, the coolant temperature control means controls the flow rate control means in such a manner that the flow rate control means stops flow of the coolant to the radiator and sets the bypass flow rate of the coolant to a level less than the bypass flow rate set for a period after the warm-up period of the internal combustion engine.

9. The abnormality diagnosis apparatus according to claim 8,

wherein when the abnormality diagnosis means diagnoses the flow rate control means, the coolant temperature control means sets the bypass flow rate of the coolant to a level that prevents seizing of the internal combustion engine.

10. A cooling system for an internal combustion engine, the cooling system comprising:

a radiator;

a circulation line system, which circulates coolant through the internal combustion engine and the radiator and includes a bypass fluid line that bypasses the radiator;

a flow rate control means for controlling a bypass flow rate of the coolant flowing through the bypass fluid line;

a coolant temperature sensor, which measures a coolant temperature of the coolant in the circulation line system;

a coolant temperature control means for controlling the coolant temperature of the coolant in the circulation line system by controlling the flow rate control means; and

an abnormality diagnosis means for diagnosing the flow rate control means to determine whether abnormality of the flow rate control means exists based on behavior of the measured coolant temperature, which is measured through the coolant temperature sensor during a warm-up period of the internal combustion engine.

11. The cooling system according to claim 10, wherein the flow rate control means includes at least one of a valve and a pump inserted in the circulation line system.